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December 15, 1992

Grant Administrator
Office of Naval Research
Resident Representative N68883
Charles S. Draper Laboratory
555 Technology Square MS54
Cambridge, MA 02139-3539

re: Grant No. N00014-92-J-1492 ¹⁴⁴²
"Workshop in Computational Neuroscience"
T. Sejnowski, PI

Dear Administrator:

Please find enclosed one copy of the proceedings of the workshop.

Sincerely,

Leslie D. Garrick, Ph.D.
Administrator

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distribution is unlimited

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Dr. Steven Zucker
Department of Electrical Engineering
McGill University
3480 University Street
Montreal, Quebec H3A 2

Summary of the Workshop:

The 8th annual Woods Hole Workshop on Computational Neuroscience was held on August 22-28, 1992 at the Marine Biological Laboratory. The two major themes this year were olfactory processing and mechanisms for coding and processing in visual cortex.

The coding of odors by olfactory receptors is still uncertain, though recent evidence from molecular genetics suggests that there may be several hundred types of receptors. John Kauer and David Kleinfeld have been using optical recording techniques to study the dynamic patterns of activity in the olfactory bulb in response to odors. Jim Bower presented evidence from chronically implanted electrodes in the olfactory bulb. These experimental results suggest that the patterns of activity are very broad across the bulb and that the temporal characteristics of the response may also carry important information about the nature of the odor. The temporal dimension has been explored in several models of olfactory coding and should be studied more closely in experiments.

Several talks on the olfactory cortex by Lewis Haberly and Michael Hasselmo made close contact with matrix models of associative memory. Once again, the temporal pattern of activity was an essential part of the operation of the cortical circuitry. The timing of impulses impinging on single pyramidal neurons in the pyriform cortex depend both on the timing of inputs from the olfactory bulb and on the dynamics of the association fibers and inhibitory interneurons. In particular there was a lively discussion on the origin and significance of 40 Hz oscillations in the olfactory cortex.

Voltage-sensitive dyes have also been used in visual cortex by Dan Tso and Gary Blasdel, who presented data from V1 and V2 that imply a significant degree of modularity in color and disparity processing within blobs and stripes. There were also regions within V2 where information on these different cues converge, which might be regions of the cortex that integrate and bind this information. Other talks by Rodney Douglas and A. B. Bonds explored properties of cortical neurons and microcircuitry that are important for temporal processing of visual information. Terry Sejnowski and Michael Shadlen addressed the issue of cortical representation using models of single units that are tuned to the motion and of visual stimuli. Steve Zucker presented a provocative new model of simple cells that are sensitive



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to 2-D curvature. His model makes strong predictions for nonlinear subfields that are amenable to experimental test. The development of cortical circuits, particularly those devoted to ocular dominance and orientation, were presented by Mike Stryker. The overall conclusions of these discussions was that temporal dynamics is an essential part of the processing and that the control of information flow through cortical circuits is an area that is becoming central to modeling and experimental studies.

Models of higher-level processing were introduced by Sandy Pentland and Dana Ballard that complemented recordings of cortical neurons during eye movements by Richard Andersen and Carol Colby. These talks raised the issue of sequential control of movements during tasks such as double saccades and eye-hand coordination. Short-term memory of visual information is quite limited and affects the control strategies that can be used in solving complex tasks.

Finally, David Tank presented exciting new results from functional MRI, a new approach to recording brain activity that is non-invasive. The time scale is currently around 1 sec but this and the spatial resolution should significantly improve. John Allman provided evidence for strong correlations between brain size and lifespan for primates.

The small size of the workshop made it possible to pursue in depth discussions both during the presentations and afterwards during free afternoons. The balance between experimental and theoretical talks was stimulating, and several ideas for new experiments and new models were generated during the course of the week. Several faculty gave tutorial talks to the students in the course "Methods in Computational Neuroscience", and all of the workshop participants participated in the student project demonstrations on Thursday afternoon.

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Workshop on Computational Neuroscience - 1992
Marine Biological Laboratory
Sponsored by the Office of Naval Research

Participants

Dr. John Allman
Division of Biology 216-76
Caltech
Pasadena, CA 91125

Dr. Richard Andersen
Department of Brain
and Cognitive Science
MIT
Cambridge, MA 02139

Dr. Dana Ballard
Department of Computer Science
University of Rochester
Rochester, NY 14627

Dr. Gary Blasdel
Department of Neurobiology
Harvard Medical School
25 Shattuck Street
Boston, MA 02115

Dr. A. B. Bonds
Department of Electrical Engineering
Vanderbilt University
Nashville, TN 37235

Dr. James Bower
Division of Biology 216-76
Caltech
Pasadena, CA 91125

Dr. Peter Broatch
Department of Brain
and Cognitive Science
MIT
Cambridge, MA 02139

Dr. Carol Colby
Lab Sensorimotor Res.
NIMH - Bldg. 10, Rm. 10C101
Bethesda, MD 20892

Dr. Joel Davis
Department of the Navy
Office of Naval Research
Arlington, VA 22217-5000

Dr. Rodney Douglas
MRC Anatomical
Neuropharmacology Unit
Mansfield Road
Oxford, OX1 3TH
England

Dr. Lewis Haberly
Department of Anatomy
University of Wisconsin
1255 Linden Dr.
Madison, WI 53706

Dr. Michael Hasselmo
Department of Psychology
Harvard University
33 Kirkland Street
Cambridge, MA 02138

Dr. John Kauer
Department of Neurosurgery
Tufts University Medical School
NE Medical Center
750 Washington Street
Boston, MA 02111

Dr. David Kleinfeld
AT&T Bell Laboratories
Room 6H 424
600 Mountain Avenue
Murray Hill, NJ 07974

Dr. Christof Koch
Division of Biology 216-76
Caltech
Pasadena, CA 91125

Mr. Mark O'Dell
Division of Biology 216-76
Caltech
Pasadena, CA 91125

Dr. Alexander Pentland
Media Laboratory
MIT
Cambridge, MA 02139

Dr. Ning Qian
Department of Brain
and Cognitive Science
MIT
Cambridge, MA 02139

Dr. Terrence J. Sejnowski
Computational Neurobiology Lab
The Salk Institute
P. O. Box 85800
San Diego, CA 92038

Dr. Michael Shadlin
Department of Neurobiology
Stanford Medical School
Stanford, CA 94395

Dr. Michael Stryker
Department of Physiology
University of California
School Of Medicine
San Francisco, CA 94143-0444

Dr. David Tank
AT&T Bell Laboratories
Room 1C 427
600 Mountain Avenue
Murray Hill, NJ 07974

Dr. Daniel Ts'o
Department of Neurobiology
Rockefeller University
Tower Building, Rm. 425
1230 York Avenue
New York, NY 10021